

Claims

Claims 1 - 38 (Cancelled)

39. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;
 - a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
 - a second end-cap closing a second end of the housing;
- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump; and
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the second chamber has a downstream portion that extends below the passageway and asymmetrically surrounds the downstream portion of the first chamber.

40. (New) Integrated blood treatment module according to claim 39, further comprising a first pressure measurement chamber that is secured to the blood treatment device and is connected to the first end of the pump hose, the first pressure measurement chamber having a pressure measurement port for connection to a pressure sensor, the pressure measurement port having a central axis that is parallel to a central axis of at least one access port of the housing.

41. (New) Integrated blood treatment module according to claim 39, further comprising a second pressure measurement chamber that is secured to the blood treatment device and is connected to

the outlet port of the blood degassing device, the second pressure measurement chamber having a pressure measurement port for connection to a pressure sensor, the pressure measurement port having a central axis that is parallel to a central axis of at least one access port of the housing.

42. (New) Integrated blood treatment module according to claim 39, further comprising a third pressure measurement chamber that is secured to the blood treatment device and is connected to the second end of the pump hose, the third pressure measurement chamber having a pressure measurement port for connection to a pressure sensor, the pressure measurement port having a central axis that is parallel to a central axis of at least one access port of the housing.

43. (New) Integrated blood treatment module according to claim 39, further comprising a support structure having a plurality of conduits defined therein, the blood treatment device being secured to the support structure.

44. (New) Integrated blood treatment module according to claim 43, wherein the support structure comprises a first conduit having a first end connected to a first access port of the housing, and a second end comprised of an outlet nozzle for a waste liquid.

45. (New) Integrated blood treatment module according to claim 43, wherein the support structure comprises a second conduit having a first end connected to a second access port of the housing, and a second end comprised of an inlet nozzle for a dialysis liquid.

46. (New) Integrated blood treatment module according to claim 43, wherein the support structure comprises:

- a third conduit having an inlet for connection to a blood withdrawal tube, and an outlet connected to the first end of the pump hose; and
- a fourth conduit having an inlet connected to the second end of the pump hose, and an outlet connected to the blood inlet port of the first end-cap.

47. (New) Integrated blood treatment module according to claim 46, wherein the support structure comprises a sixth conduit having a first end connected to the fourth conduit and a second end for connection to a pre-dilution infusion tube.
48. (New) Integrated blood treatment module according to claim 46, further comprising a first pressure measurement chamber defined within the support structure and connected to the third conduit for measuring a pressure upstream of the pump hose.
49. (New) Integrated blood treatment module according to claim 46, wherein the outlet of the third conduit and the inlet of the fourth conduit are arranged with respect to each other so that the pump hose forms a loop that extends in a plane substantially parallel to the longitudinal axis of the housing.
50. (New) Integrated blood treatment module according to claim 49, wherein the outlet of the third conduit is located between the two end-caps and the loop formed by the pump hose extends laterally with respect to the housing of the blood treatment device.
51. (New) Integrated blood treatment module according to claim 49, wherein the outlet of the third conduit is located along the longitudinal axis of the housing beyond the first end-cap, and the loop formed by the pump hose is offset along the longitudinal axis of the housing with respect to the housing of the blood treatment device.
52. (New) Integrated blood treatment module according to of claim 46, wherein the outlet of the third conduit and the inlet of the fourth conduit are arranged with respect to each other so that the pump hose forms a loop that extends in a plane inclined with respect to a plane substantially perpendicular to the longitudinal axis of the housing.
53. (New) Integrated blood treatment module according to claim 43, wherein the support structure comprises a fifth conduit having an inlet connected to the outlet port of the blood degassing device, and an outlet for connection to a blood return tube.

54. (New) Integrated blood treatment module according to claim 53, wherein the support structure comprises a seventh conduit having a first end connected to the fifth conduit and a second end for connection to a post-dilution infusion tube.

55. (New) Integrated blood treatment module according to claim 53, further comprising a second pressure measurement chamber defined within the support structure and connected to the fifth conduit for measuring a pressure downstream of the blood degassing device.

56. (New) Integrated blood treatment module according to claim 55, further comprising a first pressure measurement chamber defined within the support structure and connected to the third conduit for measuring a pressure upstream of the pump hose, wherein the first pressure measurement chamber has a port for connection to a pressure sensor, the second pressure measurement chamber has a port for connection to a pressure sensor, and wherein the inlet nozzle, the outlet nozzle, the port of the first pressure measuring chamber and the port of the second measuring chamber have respective central axes that are substantially parallel.

57. (New) Integrated blood treatment module according to claim 56, wherein the respective central axes of the inlet nozzle, of the outlet nozzle, of the port of the first pressure measuring chamber and of the port of the second measuring chamber are substantially perpendicular to the longitudinal axis of the housing.

58. (New) Integrated blood treatment module according to claim 39, wherein the downstream portion of the second chamber has a lateral wall that surrounds a longitudinal axis of the degassing device and a bottom wall that is inclined with respect to a longitudinal axis of the degassing device.

59. (New) Integrated blood treatment module according to claim 58, wherein the downstream portion of the first chamber has a lateral wall that is concentric to the lateral wall of the second chamber.

60. (New) Integrated blood treatment module according to claim 59, wherein the lateral wall of the downstream portion of the first chamber and the lateral wall of the downstream portion of the second chamber are substantially cylindrical.

61. (New) Integrated blood treatment module according to claim 39, wherein the downstream portion of the first chamber has a cross-section that is substantially the same as the cross-section of the passageway between the first and the second chamber.

62. (New) Integrated blood treatment module according to claim 39, wherein the first chamber comprises an upstream portion having a decreasing cross section.

63. (New) Integrated blood treatment module according to claim 39, wherein the second chamber comprises an upstream portion extending above the passageway that has a decreasing cross-section, with a larger cross-section that is substantially level with the passageway and a smaller cross-section that is substantially level with the hydrophobic membrane.

64. (New) Integrated blood treatment module according to claim 63, wherein the upstream portion of the second chamber is substantially frusto-conical.

65. (New) Integrated blood treatment module according to claim 39, wherein the outlet port opens in the downstream portion of the second chamber at a location furthest to the passageway.

66. (New) Integrated blood treatment module according to claim 39, wherein the first chamber of the degassing device has a downstream portion having a cross-section selected with respect to a maximal flow rate of a liquid in the module so that the velocity of the liquid in the downstream portion of the first chamber is less than a predetermined velocity.

67. (New) Integrated blood treatment module according to claim 66, wherein the cross-section of the downstream portion of the first chamber is selected with respect to a maximal flow rate of a liquid of about 500ml/min in the module so that the velocity of the liquid in the downstream portion of the first chamber is less than about 3m/min.

68. (New) Integrated blood treatment module according to claim 39, wherein the cross-section of the second chamber of the degassing device at the level of the passageway is selected so that the ratio of the velocity of a liquid within a downstream portion of the first chamber to the velocity of the liquid within the second chamber at the level of the passageway is more than a determined value.

69. (New) Integrated blood treatment module according to claim 68, wherein the cross-section of the second chamber of the degassing device at the level of the passageway is selected so that the ratio of the velocity of the liquid within the downstream portion of the first chamber to the velocity of the liquid within the second chamber at the level of the passageway is at least about 2.

70. (New) Integrated blood treatment module according to claim 39, wherein the downstream portion of the second chamber forms an overflow for a fluid flowing from the first chamber into the second chamber.

71. (New) Integrated blood treatment module according to claim 39, wherein the first chamber, the second chamber and the passageway therebetween are arranged with respect to each other so that a flow pattern of a liquid flowing from the first chamber, through the second chamber and to the outlet port comprises a component that is tangential to the membrane.

72. (New) Integrated blood treatment module according to claim 71, wherein the flow pattern of a liquid flowing from the first chamber, through the second chamber and to the outlet port comprises an umbrella like component.

73. (New) Integrated blood treatment module according to claim 39, wherein the first chamber, the second chamber and the passageway therebetween are arranged with respect to each other so that a flow of liquid flowing from the first chamber, through the second chamber and to the outlet port keeps gas bubbles in motion along an inner surface of the hydrophobic membrane.

74. (New) Integrated blood treatment module according to claim 39, further comprising a protective member for protecting the hydrophobic membrane against external blows and for limiting the deformation of the hydrophobic membrane when the pressure of the liquid within the degassing device exceeds a limit.

75. (New) Integrated blood treatment module according to claim 39, wherein the hydrophobic membrane is arranged in a plane substantially perpendicular to a longitudinal axis of the degassing device.

76. (New) Integrated blood treatment module according to one of the claims 39, wherein the blood treatment device is a hemodialyzer, a hemofilter or a plasmafilter.

77. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;
 - a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
 - a second end-cap closing a second end of the housing;
- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump;
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,
 wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the second chamber has a downstream portion that extends below the passageway and asymmetrically surrounds the downstream portion of the first chamber; and

- a support structure having a plurality of conduits defined therein, the blood treatment device being secured to the support structure.

78. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;
 - a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
 - a second end-cap closing a second end of the housing;
- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump;
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the second chamber has a downstream portion that extends below the passageway and asymmetrically surrounds the downstream portion of the first chamber; and
- a support structure having a plurality of conduits defined therein, wherein the blood treatment device is secured to the support structure, and the support structure comprises:
 - a third conduit having an inlet for connection to a blood withdrawal tube, and an outlet connected to the first end of the pump hose; and
 - a fourth conduit having an inlet connected to the second end of the pump hose, and an outlet connected to the blood inlet port of the first end-cap.

79. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;

- a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
- a second end-cap closing a second end of the housing;
- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump;
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,
 wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the second chamber has a downstream portion that extends below the passageway and asymmetrically surrounds the downstream portion of the first chamber; and
- a support structure having a plurality of conduits defined therein, wherein the blood treatment device is secured to the support structure, and the support structure comprises:
 - a third conduit having an inlet for connection to a blood withdrawal tube, and an outlet connected to the first end of the pump hose; and
 - a fourth conduit having an inlet connected to the second end of the pump hose, and an outlet connected to the blood inlet port of the first end-cap,
 wherein the outlet of the third conduit and the inlet of the fourth conduit are arranged with respect to each other so that the pump hose forms a loop that extends in a plane substantially parallel to the longitudinal axis of the housing.

80. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;
 - a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
 - a second end-cap closing a second end of the housing;

- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump;
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,
 wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the second chamber has a downstream portion that extends below the passageway and asymmetrically surrounds the downstream portion of the first chamber; and
- a support structure having a plurality of conduits defined therein, wherein the blood treatment device is secured to the support structure, and the support structure comprises:
 - a third conduit having an inlet for connection to a blood withdrawal tube, and an outlet connected to the first end of the pump hose; and
 - a fourth conduit having an inlet connected to the second end of the pump hose, and an outlet connected to the blood inlet port of the first end-cap,
 wherein the outlet of the third conduit and the inlet of the fourth conduit are arranged with respect to each other so that the pump hose forms a loop that extends in a plane inclined with respect to a plane substantially perpendicular to the longitudinal axis of the housing.

81. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;
 - a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
 - a second end-cap closing a second end of the housing;

- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump; and
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,
 wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the second chamber has a downstream portion that extends below the passageway and asymmetrically surrounds the downstream portion of the first chamber, and wherein the downstream portion of the second chamber has a lateral wall that surrounds a longitudinal axis of the degassing device and a bottom wall that is inclined with respect to a longitudinal axis of the degassing device.

82. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;
 - a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
 - a second end-cap closing a second end of the housing;
- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump; and
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the second chamber has a downstream portion that extends below the passageway and asymmetrically surrounds the downstream portion of the first chamber, and an upstream portion extending above the passageway that has a decreasing cross-section, with a larger cross-section that is substantially level with the passageway and a smaller cross-section that is substantially level with the hydrophobic membrane.

83. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;
 - a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
 - a second end-cap closing a second end of the housing;
- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump; and
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber has a downstream portion that partially extends within the second chamber, communicates therewith by a passageway, and has a cross-section selected with respect to a maximal flow rate of a liquid in the module so that the velocity of the liquid in the downstream portion of the first chamber is less than a predetermined velocity.

84. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;

- a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
- a second end-cap closing a second end of the housing;
- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump; and
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,
 wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the cross-section of the second chamber of the degassing device at the level of the passageway is selected so that the ratio of the velocity of a liquid within a downstream portion of the first chamber to the velocity of the liquid within the second chamber at the level of the passageway is more than a determined value.

85. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;
 - a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
 - a second end-cap closing a second end of the housing;
- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump; and
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and

- a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the first chamber, the second chamber and the passageway therebetween are arranged with respect to each other so that a flow pattern of a liquid flowing from the first chamber, through the second chamber and to the outlet port comprises a component that is tangential to the membrane.

86. (New) Integrated blood treatment module comprising:

- a blood treatment device having:
 - a housing having a longitudinal axis;
 - a first end-cap closing a first end of the housing, the first end-cap having a blood inlet port;
 - a second end-cap closing a second end of the housing;
- a pump hose for a peristaltic pump, wherein the pump hose has a first end that is secured to the housing and a second end that is connected to the blood inlet port so that the pump hose extends in a position that is complementary to the position of a race of a peristaltic pump; and
- a degassing device connected to the second end-cap having:
 - a first chamber having an inlet for receiving a liquid flowing into the second end-cap, and
 - a second chamber having an opening closed by a hydrophobic membrane and an outlet for discharging the liquid,

wherein the first chamber has a downstream portion that partially extends within the second chamber and communicates therewith by a passageway, and the first chamber, the second chamber and the passageway therebetween are arranged with respect to each other so that a flow of liquid flowing from the first chamber, through the second chamber and to the outlet port keeps gas bubbles in motion along an inner surface of the hydrophobic membrane.